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# LEARNING EFFECTIVENESS UNDER THE TRIMESTER SYSTEM OF SCHOOL-YEAR ORGANIZATION AT THE LINDSAY THURBER COMPOSITE HIGH SCHOOL, RED DEER, ALBERTA

by

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# ABSTRACT

The composite high school at Red Deer, Alberta, has operated since 1949 on a trimester basis, that is, a school-year divided into three equal terms. The terms are independent of one another; instruction in a given course is usually completed in one term with a formal examination at the end of the term. Several aspects of this unique organization are of interest: the efficiency of learning, the retention of what is learned, the utilization of staff and buildings and the accommodation of special students.

The specific problem in this study focused on learning effectiveness at the Red Deer school. The success of students from the Red Deer school on Grade XII Departmental examinations in English, Social Studies and Mathematics for the years 1955, 1958 and 1961 was compared with the success of students in the same subjects and for the same years from four control schools, located in similar communities and similar in size to the Red Deer school. Matched groups were used to make the comparison, the traits used in the matching process being Grade IX achievement scores, Grade IX ability scores and sex. The study was limited to the student who had progressed normally from Grade IX to Grade XII in the Red Deer school.

The comparison between the Red Deer groups and the control groups was made by means of a two-way analysis of variance. None of the differences between the two groups was found to be statistically significant. This study has shown

that the student in a trimester school suffers no disadvantage in learning effectiveness.

Several other aspects of the trimester system must be studied before its role can be validly assessed. Specifically, it is recommended that further studies be made relating to the special student, retention of learning, adaptations of programs of studies, and staff and plant utilization.

# ACKNOWLEDGEMENTS

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# CHAPTER I

# THE PROBLEM

## I. THE PROBLEM

The purpose of this study was to measure the relative success of students at the Lindsay Thurber Composite High School, Red Deer, on Grade XII Departmental examinations in English, Social Studies and Mathematics for the years 1955, 1958 and 1961.

## II. BACKGROUND OF THE STUDY

In September, 1949 the Red Deer school commenced operation on a three-term basis. The terms were approximately equal in length, the first extending from September until early December, the second from December until March and the third from March until June. Instruction in any given course was completed during the term and the students were examined at the end of the term. Those students who were successful in examinations could continue study in the same subject-matter field during the next term. Alternatively they could work toward completing requirements in other subject-matter fields for a particular grade level. Students not successful on the term-end examinations could repeat the course the next term, or they, too, could proceed with some other course and make up the deficiency during some future term.

There seem to have been two primary reasons for inaugurating this system at Red Deer.[1] In the early post-war years there was a need to provide short-term instruction in special courses for students who needed them as prerequisites to further study. It was also suggested that short-term instruction would be advantageous to farm youths who were needed at home during summer and fall months but were free to attend school during the winter and, to a lesser extent, spring terms. A departmental report of 1954 notes that earlier submissions to the Senior High School Curriculum Committee listed the following objectives:

1. Make possible attendance of rural youngsters during the winter term.
2. Make possible for certain students needing only one or two subjects to complete programs to do so without a full year's attendance at school.
3. To test the hypothesis that immediate goals are more effective than deferred goals.
4. To facilitate the scheduling of academic and shop courses in the same school.[2]

The purpose of the report was to assess the degree to which these objectives had been met. The report stated

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[1] Filed Correspondence (Edmonton: Department of Education, 1950-61).

[2] T.C. Byrne and A.B. Evenson, "The Semester Organization Red Deer Composite High School" (filed report, The Department of Education, Edmonton, December, 1954).

that the second and fourth objectives had been met. It also stated that the first objective was not a valid one because the need for providing short-term instruction to farm youths as envisaged by the planners did not exist.

The report was not able to make a clear assessment of the hypothesis that immediate goals are more effective than deferred goals. The report notes that no true experimental situation was established, consequently the evidence developed was based largely on observation and discussion. Reference was made to departmental concern with the "pedagogical soundness" of the trimester system but pedagogical soundness was not defined nor was any attempt made to measure it. There was a statement that the trimester system may have created learning conditions that promote better results on the departmental examinations. No data were presented to support this possibility.

The concern with "pedagogical soundness" has tended to diminish in reports filed with the Department of Education since 1954. The writers of a 1957 report[3] discuss the problem of setting separate departmental examinations at the end of the first two terms each year and suggest that some form of accreditation may be a possible solution. There is no mention of effectiveness of learning nor of "pedagogical soundness".

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[3] T.C. Byrne and others, "Short Term Arrangements at the Lindsay Thurber Composite High School". (Filed Report, The Department of Education, Edmonton, 1957).

The only reference to learning in relation to the peculiar organization of this school in the 1958 report was the statement that "the semester system seems to put a sense of urgency into the pupil's work".[4] A similar effect of this system is noted in the section of the 1961 report dealing with instruction in English, namely that "pupils are under constant pressure to cover a large body of material in a very limited time . . .".[5] The administrative section of this report questioned the effectiveness of the trimester system at the Grade X and XI levels and suggested that a full term could be used for these grades and that "Grade XII could continue to operate on the semester basis, if this were considered desirable."[6]

## III. IMPORTANCE OF THE STUDY

The organization of the Red Deer school is unique in the Province of Alberta. The fact that it has flourished since 1949 indicates that its advocates conclude that it has certain advantages. On the other hand, it may be the only school operating on the trimester system because some reservations about such an organization exist.

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[4] "General Report on the Lindsay Thurber Composite High School" (filed report, The Department of Education, Edmonton, 1958).

[5] "General Report of the Visit to the Lindsay Thurber Composite High School and the Riverglen High School of the Team of the Provincial High School Inspectors" (filed report, The Department of Education, Edmonton, 1961).

[6] *Ibid*.

If the trimester system has inherent weaknesses of a serious nature relating to learning effectiveness, perhaps it should be abandoned. If the method is a superior one, its application to other schools should be considered.

Problems associated with the operation of this type of school can be classified into two broad groups: those associated with the mechanical organization and those associated with learning effectiveness. Mechanical problems have caused some concern with the operation of the trimester system. The setting of departmental examinations, for example, has been particularly troublesome. The fact that the school has continued to operate indicates that these problems have not been insurmountable. The problem of learning effectiveness does not lend itself readily to such a pragmatic measure. It is of primary concern, however, and this study therefore focused on problems related to learning effectiveness. Two factors can be considered within the area of learning effectiveness: the degree to which learning takes place, and the subsequent retention of what is learned. The first of these is a necessary condition to the second. This study therefore focused on the initial learning at the Red Deer school.

## IV. DELIMITATION OF THE STUDY

The relative success of Red Deer students on the Grade XII Departmental examinations in English, Social Studies and Mathematics may be due to the combination of a number of

factors. Some of these are student attitudes and abilities, motivation, quality of teaching, community influences, and the trimester system. These variables are not necessarily independent. There is a very real possibility that the trimester system has some influence on such factors as student attitudes, motivation and quality of teaching. An attempt to control all the influences of these other variables might result in removing the influence of the trimester system.

On the other hand it seems reasonable to assume that the influence of the trimester system on such factors as ability and prior achievement will not be great. This fact may also be true with respect to cultural background. This study attempted to control ability and prior achievement as much as possible and to control broadly the influence of cultural background. Some control of the independent proportions of the other factors was exercised by studying the success over a period of time extending from 1955 to 1961.

The study focused on the effectiveness of the learning situation at the Red Deer school. The extent to which the results are applicable to trimester systems generally is limited by the degree to which achievement, ability and cultural background are not influenced by the trimester system and by the extent to which the other factors are influenced by the trimester system.

The scope of the study was limited to those mechanical details of the organization of the Red Deer school which had

relevance to the problem being studied. Neither the history of the school nor details of its operation are discussed.

## V. BASIC ASSUMPTIONS

1. Red Deer students experience the same treatment as students from the control schools in the writing of Grade IX and Grade XII Departmental June examinations in English, Social Studies and Mathematics.

2. The cultural backgrounds of students attending the Red Deer school and the other schools from which matching students are drawn are similar.

3. The trimester system has no effect on prior achievement. In other words, students in Grade IX who expect to attend the Red Deer school the next year are not motivated to work any harder in Grade IX than similar students from control schools.

## VI. DEFINITIONS

Trimester System. Trimester system is the term used to describe the type of school-year organization in use at the Red Deer school; that is, an organization by which the school year is divided into three approximately equal terms, instruction in a given course is completed during any one term, and an examination is held at the end of the term.

The system in use at Red Deer has often been called the semester system. The use of this latter term tends to be

confusing, not only because it is applied more properly to those organizations which divide the conventional year into two distinct halves, but also because the term has been applied to either of the two terms of the conventional year. The term "trimester" refers uniquely to the Red Deer system.

Divided School-Year. The divided school-year is a system of organizing the normal school-year into at least two independent terms for instructional purposes. The term "divided school-year" is an inclusive one; it includes, but not necessarily exclusively, the trimester system.

Conventional Year. Conventional year is a term used to describe those schools in which instruction in a given course is usually commenced in September and completed by the next June, at which time an examination is usually held. This term applies to the method of organizing the school year in use in the vast majority of high schools in Alberta.

Red Deer School. The term Red Deer school refers to the Lindsay Thurber Composite High School located at Red Deer, Alberta.

Red Deer Students. Red Deer students means those students who attended Grade IX in schools in the Red Deer area and who normally proceed to the Red Deer school.

Control Schools. Control schools are schools similar

in size to the Red Deer school located in communities similar to Red Deer. The control schools and the Red Deer school constitute the sampling universe.

Sampling Universe. The sampling universe was limited to the students of city school districts listed in the Fiftieth Annual Report of the Department of Education in the Province of Alberta,[7] with the exception of the Calgary and Edmonton school districts. The specific school districts constituting the sampling universe were Red Deer, Lethbridge, Drumheller, Medicine Hat and Wetaskiwin. The sampling universe consists of all students from the above schools who sat for the Departmental examination(s) in Grade IX English, Social Studies and/or Mathematics for the years 1952, 1955 and 1958 and who subsequently sat for the Grade XII Departmental examination(s) in English, Social Studies and/or Mathematics in the years 1955, 1958 and 1961 respectively.

Counterpart. A counterpart is a high school student who is similar in achievement, ability and cultural background, at the Grade IX level, to a given Red Deer student but who has not attended the Red Deer school.

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[7] Fiftieth Annual Report of the Department of Education of the Province of Alberta 1955 (Edmonton: Queen's Printer for Alberta, 1956), p. 163.

## VII. RESEARCH HYPOTHESES

The research hypotheses tested in this study can be classified into two groups. The first group of hypotheses, which consists of Major Hypothesis A and Minor Hypotheses A-1, A-2 and A-3, relates to a comparison of over-all achievement between matched groups of Red Deer and control students. These hypotheses are listed immediately below.

Major Hypothesis A. The combined achievement in English, Social Studies and Mathematics on the Grade XII Departmental examinations for the years 1955, 1958 and 1961 of the Red Deer students is significantly different from the combined achievement of the matching groups.

Minor Hypothesis A-1. The combined achievement in English, Social Studies and Mathematics on the Grade XII Departmental examinations for the year 1955 of the Red Deer students is significantly different from the combined achievement of the matching groups.

Minor Hypothesis A-2. The combined achievement in English, Social Studies and Mathematics on the Grade XII Departmental examinations for the year 1958 of the Red Deer students is significantly different from the combined achievement of the matching groups.

Minor Hypothesis A-3. The combined achievement in English, Social Studies and Mathematics on the Grade XII

Departmental examinations for the year 1961 of the Red Deer students is significantly different from the combined achievement of the matching groups.

The second group of hypotheses relates to a comparison of achievement in English and Social Studies between the Red Deer and control students at different levels of prior achievement. That is, the student groups to be compared in English and Social Studies for each of the years 1955, 1958 and 1961 were sub-divided into three groups on the basis of Grade IX achievement. Those students ranking in the bottom third within any given major group were classified as a low achievement group; those in the middle third as an average achievement group; those in the top third as a high achievement group.

The original plan was to follow the same procedure with achievement in mathematics. This was not possible because the numbers involved were too few to provide a satisfactory basis for matching of the sub-groups.

The specific hypotheses tested in this second group are listed immediately below.

Major Hypothesis B. The combined achievement for the years 1955, 1958 and 1961 in English and in Social Studies of the low achievement groups of Red Deer students is significantly different from the combined achievement for the years 1955, 1958 and 1961 of the matching groups.

Minor Hypothesis B-1. The combined achievement for the years 1955, 1958 and 1961 in English of the low achievement groups of Red Deer students is significantly different from the combined achievement for the years 1955, 1958 and 1961 of the matching groups.

Minor Hypothesis B-2. The combined achievement for the years 1955, 1958 and 1961 in Social Studies of the low achievement groups of Red Deer students is significantly different from the combined achievement for the years 1955, 1958 and 1961 of the matching groups.

Major Hypothesis C. The combined achievement for the years 1955, 1958 and 1961 in English and in Social Studies of the average achievement groups of Red Deer students is significantly different from the combined achievement for the years 1955, 1958 and 1961 of the matching groups.

Minor Hypothesis C-1. The combined achievement for the years 1955, 1958 and 1961 in English of the average achievement groups of Red Deer students is significantly different from the combined achievement for the years 1955, 1958 and 1961 of the matching groups.

Minor Hypothesis C-2. The combined achievement for the years 1955, 1958 and 1961 in Social Studies of the average achievement groups of Red Deer students is significantly different from the combined achievement for the years 1955, 1958 and 1961 of the matching groups.

Major Hypothesis D. The combined achievement for the years 1955, 1958 and 1961 in English and in Social Studies of the high achievement groups of Red Deer students is significantly different from the combined achievement for the years 1955, 1958 and 1961 of the matching groups.

Minor Hypothesis D-1. The combined achievement for the years 1955, 1958 and 1961 in English of the high achievement groups of Red Deer students is significantly different from the combined achievement for 1955, 1958 and 1961 of the matching groups.

Minor Hypothesis D-2. The combined achievement for the years 1955, 1958 and 1961 in Social Studies of the high achievement groups of Red Deer students is significantly different from the combined achievement for 1955, 1958 and 1961 of the matching groups.

# CHAPTER II

# SCHOOL-YEAR ORGANIZATION

## I. INTRODUCTION

The purpose of this chapter is to supply a context for the research hypotheses listed in Chapter I.

The essence of the trimester system is that a standard year-long course is compressed into a time-span of approximately three months. Canadian universities have used a similar compression of time in their summer school programs for many years.[8] However no controlled studies comparing the learning effectiveness at summer school with learning effectiveness during the normal winter term exist. Absence of such reports may be due to the difficulties involved in controlling the many variables related to summer school and winter-term instruction. In any case it is not possible to formulate the research hypotheses on the basis of past research evidence.

An alternative approach is to review the historical development and the present status of the conventional school-year organization to determine whether there are sound pedagogical reasons underlying our present system. Further insight

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[8] C.E. Phillips, The Development of Education in Canada (Toronto: W.J. Gage and Company, 1957), p. 243.

may be gained from a study of the four-quarter plan used earlier in this century in the United States.

## II. THE CONVENTIONAL SCHOOL-YEAR ORGANIZATION

The unit of instructional time in use in the majority of Canadian schools is a school-year commencing in September and ending in June. Programs of studies are adapted to this unit and a subject-year contains sufficient material to be covered in somewhat less than two hundred days. In June the student is examined. If successful, he proceeds to the next higher level in the particular subject-matter field the next September.

The evolution of such a time unit seems to have been haphazard. Phillips states that in the early nineteenth century Canadian schools operated for a winter or spring term of six months.[9] Central authorities subsequently felt it was desirable to lengthen the school year to ten months or more. During the latter half of the nineteenth century a trend developed toward a five-day week with schools in session all year except for a two-week vacation at Christmas and a four-week vacation during the summer.

Early in the twentieth century the modern pattern of a school-year extending from September to June, with short vacation periods at Christmas and Easter, emerged. Phillips

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[9] *Ibid*. p. 242-243.

attributes the development of this pattern to three factors: prosperity, consideration for the children and establishment of summer schools for the professional improvement of teachers.[10]

Recent reports of Royal Commissions on education for the provinces of Ontario, Manitoba and British Columbia express general satisfaction with the modern pattern of school-year organization, although there are minor exceptions. The Royal Commission in Ontario expressed the general consensus when it recommended "the present statutory requirements in regard to school terms . . . be continued and specified in the proposed Education Act".[11]

The Commission in Manitoba was generally satisfied with the school-year organization in that province. It did feel that the division of the school-year into three regular periods would eliminate "the annual irregularity occasioned by the variability of Easter".[12] The Commission also recommended that the required number of teaching days be set at 195, as opposed to the present number of 200 days. This latter recommendation contradicts one of those made by the Royal Commission on Education in British Columbia. The

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[10] *Ibid*. p. 243.

[11] *Report of the Royal Commission on Education in Ontario* (Toronto: Baptist Johnston, Printer to the King's Most Excellent Majesty, 1950), p. 173-4.

[12] *Report of the Manitoba Royal Commission on Education 1959* (Winnipeg: The Queen's Printer, 1959), p. 264.

British Columbia Commission believed that the normal school year of 190-195 days in British Columbia was too short and recommended that the school year be lengthened to a minimum of 200 days.[13]

Although none of the commissions in the foregoing provinces discussed the divided school-year, the Royal Commission on Education for the Province of Alberta[14] displayed interest in the possibilities of a divided school-year for instruction in Alberta secondary schools. The interest may have been due, in part, to the actual operation of the Red Deer school and, in part, to the briefs submitted to the Commission relating to semester and trimester systems of school-year operation. Although these briefs are based largely on opinion and speculation, they are of interest because they are among the few recorded statements about the divided school-year.

The River Glen Home and School Association of Red Deer presented a brief to the Alberta Royal Commission which supported the trimester system in use at the Red Deer school.[15]

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[13] Report of the Royal Commission on Education Province of British Columbia 1960 (Victoria: The Queen's Printer, 1960), p. 66.

[14] Report of the Royal Commission on Education in Alberta 1959 (Edmonton: The Queen's Printer, 1959) chapter 29.

[15] A Brief to be presented to The Cameron Royal Commission on Education in Alberta by the River Glen Home and School Association, Red Deer. Subject: The Composite High School.

This brief claimed that the percentage of passes in academic subjects increased following the introduction of the trimester system. The brief also said:

> The Lindsay Thurber enjoys a high retention of students. Its drop-out figures before Grade XII examinations are reached is 30% compared with 58% at Ponoka, Lacombe, Camrose and Leduc. Among reasons put forward by students for remaining at school were:- (a) the three-term year; . . . (b) the limited number of subjects handled at one time.

The submission of the River Glen Home and School Association recommended that the three-term year be retained at the Red Deer school.

The Fairview Chamber of Commerce also supported the trimester system.[16] The Chamber expressed the opinion that the average pupil would benefit from such a system because he could take fewer courses during the normal school-year and remove any deficiency in July and August. The Chamber also felt the semester system would be of benefit to those students who had failed and wished to repeat a course.

Qualified approval of the trimester system was given by the Trustees of the Medicine Hat School Division. They said:

> This board sees no value in a semester system, except in the way it is used at Red Deer -- as a way to take one or two subjects during winter or summer. One or two such schools in the province would be enough. The semester system would be a "cramming" system, if generally adopted.[17]

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[16] Brief for Presentation to the Cameron Royal Commission on Education by the Fairview Chamber of Commerce.

[17] Brief to the Royal Commission on Education, submitted by the Board of Trustees of the Medicine Hat School Division No. 4.

The Alberta Teachers' Association, in a brief submitted to the Commission, maintained that students were encouraged by the advantages of short-term instruction to return to school. Drop-outs were fewer and more economical use could be made of the school plant. The Association recommended that a study be made of the optimum length of class instruction periods, the relative merits of two terms over three, the retention of subject matter by pupils and their subsequent success at university.[18]

The Faculty of Education at the University of Alberta suggested to the Commission that the present school and university year was too rigid.[19] The Faculty recommended that a study be made of the advantages and disadvantages of the divided-year type of organization for the secondary school and university and that appropriate action should be taken.[20]

In assessing these briefs, the Report of the Royal Commission on Education in Alberta[21] had this to say:

> The Commission heard a number of submissions with reference to the divided school year, the advantages of which may be briefly cited as follows:
>
> 1. To provide greater flexibility in taking care of differences in speed of learning and of mental capacity.

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[18] Alberta Teachers' Association Brief to Alberta Royal Commission on Education (1958).

[19] Faculty of Education, University of Alberta Brief to the Alberta Royal Commission on Education (1958), Part 2, p. 108.

[20] *Ibid.*, p. 113.

[21] *Op. cit.*, p. 261.

2. To make it possible to enrich and accelerate the high school program for the gifted and provide more challenge to all.
3. To facilitate the return to school of those who may have dropped out, and who for various reasons could not go back on the ordinary school-year basis.
4. To facilitate the completion of a high-school program by providing an easy means of working off credit deficiencies.
5. To facilitate the organization of the student's earning power so as to take advantage of peak employment periods.
6. To facilitate the more complete use of the teaching plant, thus reducing the capital cost ratio per student.

The Commission made the following recommendations with respect to the divided school-year:

257. That the Educational Planning Commission or a committee representing the University and the Department of Education, and including qualified representatives of the public, be convened to study the divided school year and its implementation in the whole educational system.
258. That in the event of decision to adopt the divided school year, the Department of Education govern its application in all non-accredited schools.
259. That in the event of a decision not to adopt the divided school year provision be made to operate Community Colleges and other selected schools on a quarter basis.[22]

Although the Commission does not discuss learning effectiveness directly, implicit in its summary of advantages and its recommendations is the understanding that learning effectiveness under the trimester system is at least equal to that under the normal school year organization.

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[22] Ibid., p. 263.

## III. THE FOUR-QUARTER SYSTEM

The four-quarter system is a plan by which the school program is organized into four quarters of twelve weeks each. Under the plan, as summarized by McCarty[23], three-fourths of the school-age children are in attendance during each quarter and one-fourth of the pupils are always out of school. The underlying advantage of this system is that it increases the available space by one-third without the necessity of providing additional facilities.

The system achieved some popularity in the United States during the first three decades of this century. Bluffton, Indiana, was the first district to organize schools on the four-quarter plan, in 1904. By 1925 thirteen American cities had some or all of their schools so organized. The system was adopted in Newark, New Jersey, in districts where the population was predominantly foreign born. It was hoped that this type of organization would assist in overcoming the retardation and pre-high school dropouts of pupils from non-English speaking families. The Board of Education considered abolishing the plan in 1925 and retained a consultant to appraise the plan and make recommendations. The consultant recommended that the plan be continued but it was dropped by the Board.

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[23] Donald J. McCarty, "Is the All-Year School the Answer?", *The Administrator's Notebook*, 6:6, February, 1958.

The four-quarter plan was also tried in Aliquippa, Pennsylvania, in 1928. Its purpose was to ameliorate the overcrowded conditions in schools, resulting from a sudden increase in population. The population in this area subsequently declined during the depression years and the plan was dropped in 1938. Vanderslice, the Superintendent of Schools at Aliquippa during this period, feels that the quarter system had no adverse effect on pupil growth.[24] He states that attendance and achievement in the summer quarters surpassed that of the winter ones. Most arguments against the plan, according to him, have little or no validity. His strongest plea is that the quarter system significantly reduces capital costs in education.

An intensive study of the four-quarter plan was made by the Los Angeles City School Districts in 1958.[25] This study concluded that the organizational implications were too overwhelming to warrant adoption of the plan. One of the greatest obstacles was the inertia of the community -- its resistance to such a fundamental change requiring readjustments for pupils, parents and teachers. For this reason the plan was not adopted.

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[24] H.R. Vanderslice, "What One Town Learned in 10 Years of Year-Round School.", U.S. News & World Report, August 2, 1957, pp. 48-51.

[25] Committee to study the All-Year School, The All-Year School (Los Angeles: Los Angeles City School Districts, 1954).

McCarty[26] summarizes the advantages of the plan as follows: more efficient use of existing facilities, less overcrowding, reduced capital expenditure, full year employment of teachers, no detrimental physical or mental effects and easier acceleration into high school. He states that there are very strong practical objections to the plan. The more important of these he lists as: no extra days are added to the school year; pupils are assigned arbitrarily; family vacations are disrupted; and the problem of maintaining school buildings and facilities is complicated. He also states that administrative problems would lead to innumerable complications.

## IV. CONCLUSIONS

The advantages of a divided school-year may be summarized from the foregoing statements as follows: increased flexibility in course planning and tempo, easier acceleration of students and more efficient accommodation of special students who wish to work off credit deficiencies or who wish to return to school due to technological displacement in the labor market. If the school is to operate on a twelve-month basis there are the added advantages of reduced capital cost ratios and more efficient use of the teaching staff. The major disadvantage of the divided school-year appears to be

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[26] *Op. cit.*

the problem of administering the plan.

The River Glen Home and School Association of Red Deer claims another advantage: learning effectiveness has increased in the Red Deer school since the trimester system was introduced in 1949. The claim, however, should be treated with caution. It is possible that the increase in achievement of students from the Red Deer school coincided with a general increase in achievement of students from schools of similar size throughout the province. It is also possible that other conditions changed within the Red Deer school coincident with the introduction of the trimester system, resulting in an improvement in the achievement of the Red Deer students.

Written discussion on the divided school-year has tended to focus on economic and administrative factors. Implicit in much of this discussion is the understanding that learning effectiveness is at least equal to that under the conventional method of organizing the school-year. In the few cases where academic success is mentioned, the statements are open to question due to the lack of objective supporting evidence. Moreover, three out of four Royal Commissions on Education omitted all mention of the divided school-year from their reports, leading to a possible conclusion that Canadian educators are generally satisfied with learning effectiveness under the conventional year.

There is no firm evidence to indicate that learning effectiveness might be better, or worse, under the trimester

system than under a conventional system. Although the research hypotheses state that there are significant differences in achievement between the two groups, it would not be prudent to assign a direction to these differences. Therefore the research hypotheses are non-directional.

# CHAPTER III

# COLLECTION AND CONSOLIDATION OF THE DATA

## I. INTRODUCTION

The purpose of this chapter is to describe the collection of the data and the special adaptations needed in consolidating the data for statistical treatment.

## II. COLLECTION OF THE DATA

All data relating to the problem were collected from official files of the Department of Education in Edmonton. Data recorded included achievement scores for Grade IX English, social studies and mathematics. The original intention was to record achievement in other academic subjects as well. This was not practical because the three-term nature of the Red Deer school, and the fact that only Red Deer students in the third term of each of the years studied were included in the study, reduced the number of students to only a very few in some cases. The number of students was reduced still further when those students who had not progressed normally from Grade IX to Grade XII, either in the Red Deer community exclusively or a particular control school community exclusively, were rejected.

The achievement score of each Red Deer student who wrote the Grade XII departmental examination in English

and/or social studies and/or mathematics for the years 1955, 1958 and 1961 was recorded. The score on the relevant Grade IX departmental examination was recorded next provided the student wrote the examination three years earlier. Those students who failed to do so were rejected because they had failed to meet the criterion of normal progress. A similar process was used to record the achievement scores of the students from control schools. The Grade IX ability score and sex of each student included in the study were also recorded.

## III. MATCHING OF THE GROUPS

### Purpose

Matched groups were used in this study in order to control some of the influences of those extraneous variables which might effect the relative success of the groups on the Grade XII departmental examinations. Guilford[27] warns that the matching process, if it is to be of any value, must be on the basis of some trait that relates to the measurements on which the two groups are going to be compared. The primary trait used for matching in this study was the relevant achievement score on the Grade IX departmental examinations.

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[27] J.P. Guilford, Fundamental Statistics in Psychology and Education (Toronto: McGraw-Hill Book Company, 1956), pp. 189-90.

The groups were also matched on the basis of Grade IX ability scores and sex. The groups were also matched on the basis of cultural background to the extent that the Red Deer school community and the control school communities are similar in this respect.

The research hypotheses were tested by using an analysis of variance design. When such is the case, the advantage of using matched groups is that, in the absence of treatment effects,[28] the groups will be more nearly homogeneous than groups formed by selecting individuals completely at random.[29] Improved homogeneity will reduce the magnitude of the error mean square. This, in turn, increases the possibility of discovering a significant difference between the Red Deer and control schools if such a difference exists. Matching increases the power of the analysis. The possibility of accepting the null hypothesis when it should be rejected is diminished. That is, matching reduces the possibility of committing Type II errors.[30]

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[28] The particular treatment effect in this study was the trimester system of school-year organization.

[29] A.L. Edwards, Experimental Design in Psychological Research (New York: Rinehart & Company Inc., 1960), pp. 158-59.

[30] Ibid., p. 19.

## Matching Process

Selltiz and others[31] describe two common methods of matching: precision control and frequency distribution control. In the former method, members in the groups are matched individual by individual. In the latter method, the matching is on a group basis. Paired individuals are ignored but an attempt is made to have the averages and ranges in variations between groups as nearly equal as possible.

Precision control matching has the theoretical advantage of producing a higher degree of homogeneity between groups. In practice, the process is a very difficult task. A large number of cases is needed in order to achieve adequate pairing. It is difficult to know which factors, of the many possible relevant ones, are the most important to use in obtaining precision control. If the matching process is on more than one factor, a satisfactory degree of precision control is rarely possible.[32] Moreover, Walker and Lev express serious objections to the process of matching individual for individual on background traits:

> (2) Some of the cases, sometimes an alarmingly large number have to be eliminated because no mates can be found. Thus sample size is reduced and reliability is sacrificed.

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[31] Claire Selltiz and others, Research Methods in Social Relations (New York: Henry Holt & Company Inc., 1960), pp. 104-08.

[32] Ibid., p. 105.

> (3) Very often the cases finally retained at the conclusion of the matching process are not representative of either of the original populations. Therefore generalizations from the sample of matched pairs can be made only to a universe of matched pairs and not to the two universes as originally defined.[33]

It was possible to avoid the above hazards in this study by means of frequency distribution control matching. Equal numbers of Red Deer and control students within a given group were used in the matching process. The use of equal numbers increased the possibility, but did not necessarily guarantee, that when the matched groups had similar means and standard deviations they would also have similar characteristics of skewness and kurtosis. There were considerably more control students than Red Deer students in any given sub-class (Table I). Because equal numbers in the sub-classes were used, it was not necessary to eliminate any of the Red Deer students. The control population offered many opportunities for varied selection of control students.

The use of equal numbers of Red Deer and control students within a given pair of matched groups made it possible to randomize some of the influence of uncontrolled extraneous variables. When a given control student was desired for inclusion in the groups during the matching

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[33] H.M. Walker and J. Lev, Statistical Inference (New York: Henry Holt and Company, 1953), p. 383.

### TABLE I

### COMPOSITION OF SAMPLING UNIVERSES (NUMBERS OF RED DEER AND CONTROL STUDENTS)

| | | 1955 | 1958 | 1961 |
|---|---|---|---|---|
| English | Red Deer | 34 | 40 | 80 |
| | Control Schools | 246 | 331 | 484 |
| Social Studies | Red Deer | 26 | 28 | 39 |
| | Control Schools | 250 | 329 | 516 |
| Mathematics | Red Deer | 19 | 16 | 14 |
| | Control Schools | 120 | 213 | 285 |

process, it was frequently possible to select this student from a group of several, all of whom had identical achievement scores, ability scores and sex. The selection was made on a random basis.

## The Matched Groups

Means and standard deviations of the matched groups are presented in Table II, page 33, Table III, page 34, and Table IV, page 35. An inspection of the means within any matched group indicates that the differences are not significant. The differences between means are so small and the corresponding standard deviations are, by comparison, so much larger that t-ratios are far below levels of significance. The fact that differences between means are not significant does not necessarily imply that the two populations are equivalent within any matched group. Selltiz and others express this reservation:

> It is a logical fallacy to assume that if you have not conclusively demonstrated things to be unequal, you have demonstrated them to be equal. The differences between the two groups should be as small as it is possible to make them with the available resources. Again, it should be remembered that, ideally, randomization should always be used to equate the unmatched factors whenever precision or frequency distribution control is used.[34]

In summary, the purpose of matching groups is to attempt to increase the homogeneity between groups. The

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[34] Selltiz and others, op. cit., p. 108.

## TABLE II

## COMPARISON OF MATCHED GROUPS - RED DEER AND CONTROL STUDENTS 1955

| Subject | Grade IX Achievement Level | Number in Each Sub-Group | Grade IX Achievement | | | | Grade IX Ability | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | | Standard Deviation | | Mean | | Standard Deviation | |
| | | | Red Deer | Control | Red Deer | Control | Red Deer | Control | Red Deer | Control |
| English | Top Third | 11 | 80.8 | 80.8 | 6.47 | 6.93 | 79.1 | 79.3 | 13.43 | 12.64 |
| | Middle Third | 12 | 65.1 | 65.1 | 3.43 | 3.47 | 66.1 | 66.2 | 14.91 | 13.63 |
| | Bottom Third | 11 | 46.6 | 46.7 | 7.30 | 6.54 | 42.7 | 42.5 | 10.13 | 10.36 |
| | Total | 34 | 64.2 | 64.2 | 14.96 | 15.02 | 62.7 | 62.8 | 19.87 | 19.33 |
| Social Studies | Top Third | 9 | 79.2 | 79.2 | 5.84 | 6.23 | 84.2 | 84.2 | 10.3 | 7.7 |
| | Middle Third | 8 | 62.6 | 62.8 | 6.35 | 5.71 | 71.2 | 71.2 | 18.8 | 15.7 |
| | Bottom Third | 9 | 46.4 | 46.3 | 4.82 | 4.92 | 40.4 | 40.5 | 11.0 | 10.5 |
| | Total | 26 | 62.8 | 62.8 | 14.52 | 14.67 | 65.1 | 65.1 | 22.98 | 21.88 |
| Mathematics | Total | 19 | 70.1 | 70.2 | 15.07 | 14.99 | 74.2 | 74.1 | 18.04 | 17.25 |

## TABLE III

## COMPARISON OF MATCHED GROUPS - RED DEER AND CONTROL STUDENTS
1958

| Subject | Grade IX Achievement Level | Number in Each Sub-Group | Grade IX Achievement | | | | Grade IX Ability | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | | Standard Deviation | | Mean | | Standard Deviation | |
| | | | Red Deer | Control | Red Deer | Control | Red Deer | Control | Red Deer | Control |
| English | Top Third | 12 | 86.8 | 86.8 | 5.2 | 5.3 | 87.4 | 87.4 | 11.8 | 11.8 |
| | Middle Third | 14 | 74.9 | 75.0 | 3.1 | 3.3 | 80.1 | 80.3 | 16.9 | 16.1 |
| | Bottom Third | 14 | 59.2 | 59.2 | 7.1 | 7.2 | 54.1 | 54.0 | 24.1 | 25.0 |
| | Total | 40 | 73.0 | 73.0 | 12.2 | 12.5 | 73.2 | 73.2 | 23.4 | 23.6 |
| Social Studies | Top Third | 9 | 86.3 | 86.3 | 3.5 | 3.9 | 89.9 | 89.8 | 9.3 | 8.9 |
| | Middle Third | 9 | 72.9 | 72.8 | 2.9 | 2.9 | 68.4 | 68.4 | 15.4 | 15.8 |
| | Bottom Third | 10 | 56.7 | 56.7 | 7.6 | 7.2 | 47.7 | 47.7 | 30.3 | 30.8 |
| | Total | 28 | 71.4 | 71.4 | 13.4 | 13.2 | 67.9 | 67.9 | 27.1 | 27.3 |
| Mathematics | Total | 16 | 68.7 | 68.7 | 10.3 | 10.2 | 67.1 | 67.1 | 26.1 | 22.4 |

## TABLE IV

## COMPARISON OF MATCHED GROUPS - RED DEER AND CONTROL STUDENTS
1961

| Subject | Grade IX Achievement Level | Number in Each Sub-Group | Grade IX Achievement |  |  |  | Grade IX Ability* |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Mean |  | Standard Deviation |  | Mean |  | Standard Deviation |  |
|  |  |  | Red Deer | Control | Red Deer | Control | Red Deer | Control | Red Deer | Control |
| English | Top Third | 23 | 83.7 | 83.7 | 3.29 | 3.36 | 7.70 | 7.70 | 1.28 | 1.28 |
|  | Middle Third | 28 | 73.1 | 73.1 | 3.07 | 3.07 | 6.43 | 6.43 | 1.50 | 1.42 |
|  | Bottom Third | 27 | 59.0 | 59.0 | 6.95 | 6.86 | 5.37 | 5.44 | 1.86 | 1.53 |
|  | Total | 78 | 71.4 | 71.4 | 11.06 | 11.07 | 6.44 | 6.46 | 1.79 | 1.64 |
| Social Studies | Top Third | 13 | 86.5 | 86.5 | 3.82 | 3.86 | 7.69 | 7.69 | 0.99 | 0.99 |
|  | Middle Third | 13 | 72.3 | 72.3 | 4.50 | 4.50 | 5.92 | 6.00 | 1.39 | 1.52 |
|  | Bottom Third | 13 | 58.8 | 58.8 | 4.79 | 4.78 | 4.92 | 4.85 | 1.07 | 1.12 |
|  | Total | 39 | 72.5 | 72.5 | 12.10 | 12.13 | 6.18 | 6.18 | 1.63 | 1.71 |
| Mathematics | Total | 14 | 77.2 | 77.2 | 9.84 | 9.71 | 7.21 | 7.21 | 1.74 | 1.74 |

*Grade IX ability scores in stanines.

absence of significant differences between means does not necessarily imply that satisfactory homogeneity has been attained. However, the extent to which homogeneity has been attained will be reflected in the sensitivity of the analysis of the data.

## Transformations of Achievement Scores

A summary of the mean achievement scores is presented in Table V. This table lists the mean achievement of Red Deer and control students in Grade XII English, social studies and mathematics for each of the years 1955, 1958 and 1961. Row means and column means are also listed. The row means indicate the over-all average achievement of both groups in each of English, social studies and mathematics for the years 1955, 1958 and 1961. The column means indicate the average achievement, by years, in English, social studies and mathematics for each of the two groups.

The research hypotheses in this study dealt with a comparison of Red Deer and control students. That is, the hypotheses were concerned with differences between column means. Row means could be used to compare differences among academic subjects. Such a comparison, however, had no relevance to the research hypotheses. It was possible that the variance associated with rows would spuriously mask the influence of the variance associated with columns. Therefore the achievement scores were standardized to a mean of 50 and

## TABLE V

## UNADJUSTED MEAN ACHIEVEMENT SCORES IN GRADE XII DEPARTMENTAL EXAMINATIONS

| Year | Subject | Red Deer | Control | Average |
|---|---|---|---|---|
| 1955 | English | 55.3 | 55.0 | 55.2 |
| | Social Studies | 60.6 | 56.3 | 58.4 |
| | Mathematics | 50.6 | 47.3 | 49.0 |
| 1958 | English | 62.6 | 60.3 | 61.5 |
| | Social Studies | 60.2 | 59.8 | 60.0 |
| | Mathematics | 53.2 | 45.0 | 49.1 |
| 1961 | English | 59.6 | 58.5 | 59.1 |
| | Social Studies | 60.0 | 59.8 | 59.9 |
| | Mathematics | 64.4 | 51.3 | 57.9 |

a standard deviation of 10 for any matched group (Table VI). The effect of such a linear transformation was to equate all row means without changing characteristics of the distribution within cells.[35] The relative achievement of the Red Deer and control students within any given matched group remained the same; the average achievement of the group had been adjusted to a mean of 50 and a standard deviation of 10.

The masking effect of the spurious variance associated with rows could have been controlled by pooling this variance with the error variance, but there were added advantages in using transformed scores. In the first place, different student populations are involved in the different subjects for a given year, particularly among the Red Deer groups. The usual practice under the trimester system is for a student to register in one or two courses only during a given term.[36] Standardizing the achievement scores of the matched groups equated the average achievement and variance of these different populations of matched groups.

Standardized scores simplified the research design. The achievement in all subjects during a given year for each of the Red Deer and control groups was combined. It then

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[35] H.E. Garrett, Statistics in Psychology and Education (Toronto: Longmans, Green and Company, 1958), pp. 312-13.

[36] Although there were several cases in which a student wrote examinations in June in two of the three subjects under study, cases where a given student sat for three examinations were rare.

TABLE VI

MEAN ACHIEVEMENT SCORES ADJUSTED TO ROW MEANS OF 50 AND ROW STANDARD DEVIATIONS OF 10

| Year | Subject | Red Deer | Control | Total* |
|---|---|---|---|---|
| 1955 | English | 50.1 | 49.8 | 49.9 |
| | Social Studies | 50.0 | 48.7 | 49.8 |
| | Mathematics | 51.5 | 48.3 | 49.9 |
| | Total | 50.7 | 49.1 | |
| 1958 | English | 50.8 | 49.0 | 49.9 |
| | Social Studies | 50.1 | 49.9 | 50.0 |
| | Mathematics | 51.5 | 47.2 | 49.3 |
| | Total | 50.7 | 48.9 | |
| 1961 | English | 50.6 | 49.7 | 50.2 |
| | Social Studies | 50.0 | 49.9 | 50.0 |
| | Mathematics | 54.4 | 45.5 | 50.0 |
| | Total | 50.9 | 49.3 | |

*Error due to rounding appears in third significant figure of row means.

became possible to test for total treatment effects of the three years under study (Major research hypothesis A). Another advantage of combining the achievement in all subjects for a given year was that the influences of uncontrolled extraneous variables, for example teacher competence, within any given subject were minimized. Furthermore, the significance of the interaction in the analysis of variance gave an indication of the consistency of the uncontrolled variables over the years 1955, 1958 and 1961.

# CHAPTER IV

# ANALYSIS OF THE DATA

## I. INTRODUCTION

The research hypotheses were tested by means of a two-way analysis of variance of the data. The advantage of using an analysis of variance is that the significance of the total treatment effects can be measured. The advantage of using a two-way analysis is that the significance of the differences among row means and the significance of the differences among column means can be measured. Furthermore, a two-way analysis of variance determines if there is a significant interaction between row and column means.[37]

A three-dimensional design would have been more elegant. For example, in testing major research hypothesis A by means of a two-way analysis (Schools by Years), the combined achievement in English, social studies and mathematics was used. A three-way analysis (Schools by Subjects by Years) would supply the same information, and in addition facilitate measuring the significance of relative differences in achievement among the academic subjects for Red Deer and control

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[37] E.F. Lindquist, Design and Analysis of Experiments in Psychology and Education (Boston: Houghton Mifflin Company, 1953), p. 122.

students. Major research hypotheses B, C and D could be tested together by means of a three-way analysis of variance. As it was, three two-way analyses were required.

A three-way analysis was not used because frequencies in the subclasses were unequal. Johnson and Jackson summarize the difficulties involved in such a case:

> . . . in any design more complex than a two-way classification the use of unequal numbers in the subclasses may present almost unsurmountable obstacles to a satisfactory solution, both from the point of view of the arithmetic involved in the calculations and the interpretations of the results finally secured for the analysis of variance table or tables.[38]

The problem in setting up the research design was to choose between a two-way analysis with unequal frequencies in the subclasses and a three-way analysis with equal frequencies in the subclasses. Had the latter design been adopted, it would have meant reducing the number of participants in all other groups to, at most, the level of the Red Deer mathematics group for 1961 (Table I, page 31). The inclusion of all of the Red Deer students in the sampling universe eliminated any influence of random variation in achievement of the Red Deer students. In other words, the achievement of all of the Red Deer students is the achievement of the sampling universe of Red Deer students. Therefore a two-way analysis with unequal frequencies was used.

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[38] P.O. Johnson and R.W.B. Jackson, Modern Statistical Methods: Descriptive and Inductive (Chicago: Rand McNally & Company, 1959), p. 235.

## II. TWO-WAY ANALYSIS WITH UNEQUAL FREQUENCIES

An exact computation of sums of squares becomes very complex even in a two-way analysis of variance, if an exact solution is desired. Therefore an approximate method, described by Walker and Lev[39] was used. The essence of this method is that an error mean square is derived from residual deviations about the grand mean. The error mean square, which is weighted by using a correction factor based on within-cells frequencies, is used as the denominator in the analysis of variance. The sums of squares for rows, columns and interaction are then computed by treating the mean of each of the subclasses as a single observation.

## III. MAJOR HYPOTHESIS A AND MINOR HYPOTHESES A-1 TO A-3

Major hypothesis A states that the combined achievement in English, Social Studies and Mathematics on the Grade XII Departmental examinations for the years 1955, 1958 and 1961 of the Red Deer students is significantly different from the combined achievement of the matching groups. The data used to test major hypothesis A are presented in Table VII. The analysis of variance is presented in Table VIII, page 45.

The analysis of variance enables the testing of the following null hypotheses: (1) the hypothesis that the row

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[39] *Op. cit.*, pp. 381-82.

## TABLE VII

## DATA FOR THE ANALYSIS OF VARIANCE: AGGREGATE ACHIEVEMENT IN ENGLISH, SOCIAL STUDIES AND MATHEMATICS ON GRADE XII DEPARTMENTAL EXAMINATIONS OF RED DEER AND CONTROL STUDENTS (COLUMNS) FOR THE YEARS 1955, 1958 and 1961 (ROWS)

| Year | Item | School | | Totals and Means |
|---|---|---|---|---|
| | | Red Deer | Control | |
| 1955 | N | 79 | 79 | 158 |
| | X | 4006.2 | 3875.5 | 7881.7 |
| | $\Sigma X^2$ | 210378.84 | 199102.75 | 409481.59 |
| | X | 50.7 | 49.1 | 49.9 |
| 1958 | N | 84 | 84 | 168 |
| | X | 4258.9 | 4110.7 | 8369.6 |
| | $\Sigma X^2$ | 224614.33 | 209227.55 | 433841.88 |
| | X | 50.7 | 48.9 | 49.8 |
| 1961 | N | 131 | 131 | 262 |
| | X | 6662.6 | 6462.7 | 13125.3 |
| | $\Sigma X^2$ | 351908.36 | 332252.75 | 684161.11 |
| | X | 50.9 | 49.3 | 50.1 |
| Totals and Means | N | 294 | 294 | 588 |
| | X | 14927.7 | 14448.9 | 29376.6 |
| | $\Sigma X^2$ | 786901.53 | 740583.05 | 1527484.58 |
| | X | 50.8 | 49.1 | 50.0 |

means are equal, (2) the hypothesis that the column means are equal, and (3) the hypothesis that the interaction is zero.

TABLE VIII

SUMMARY OF ANALYSIS OF VARIANCE FOR DATA PRESENTED IN TABLE VII

| Source of Variation | Sum of Squares | Degrees Freedom | Mean Square | F-ratio | $F_{05}$ |
|---|---|---|---|---|---|
| Schools | 4.16 | 1 | 4.16 | 3.78 | 3.86 |
| Subjects | 0.09 | 2 | | | |
| Interaction | 0.02 | 2 | | | |
| Error | | 582 | 1.10 | | |

### The Hypothesis that the Row Means are Equal

The testing of this hypothesis determines if there are significant differences in achievement among the years 1955, 1958 and 1961. Significant differences would not be expected in this case because achievement scores had been adjusted, by rows, to a mean of 50. In fact the sum of squares for rows is 0.09, resulting in an F-ratio much less than unity. The hypothesis that the row means are equal is accepted.

### The Hypothesis that the Column Means are Equal

The testing of this hypothesis determines if there are significant differences in total average achievement between Red Deer and control students for the years 1955, 1958 and 1961. The means square for columns is 4.16. The error mean square is

1.10. The resulting F-ratio of 3.78 is not significant at the .05 level of significance. The hypothesis that the column means are equal is accepted.

Acceptance of the hypothesis that the column means are equal leads to rejection of major hypothesis A. Rejection of major hypothesis A leads to rejection of minor hypotheses A-1, A-2 and A-3.[40]

### The Hypothesis that the Interaction is Zero

Acceptance of this hypothesis would indicate that the relative achievement of the Red Deer and control students remained consistent during the three years studied. Rejection of this hypothesis would indicate inconsistency in achievement between Red Deer and control students during the years 1955, 1958 and 1961. The sum of squares for interaction is 0.02. The resulting F-ratio is less than unity. The hypothesis that the interaction is zero is accepted.

## IV. MAJOR HYPOTHESIS B AND MINOR HYPOTHESES B-1 & B-2

Major hypothesis B states that the combined achievement for the years 1955, 1958 and 1961 in English and in Social Studies of the low achievement groups of Red Deer

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[40] It is not wise to continue testing the subordinate hypotheses when the major hypothesis has shown the over-all differences due to treatment effects to be insignificant. At the 5% level, 1 out of 20 of these differences could indicate significance due to the effect of chance variation. See Garrett, *op. cit.*, p. 287.

students is significantly different from the combined achievement of the matching groups. The data used to test major hypothesis B are presented in Table IX. The analysis of variance is presented in Table X, page 49.

The analysis of variance enables the testing of the following null hypotheses: (1) the hypothesis that the row means are equal, (2) the hypothesis that the column means are equal, and (3) the hypothesis that the interaction is zero.

### The Hypothesis that the Row Means are Equal

The testing of this hypothesis determines if there is a significant difference in achievement between English and Social Studies by the matched groups in the low achievement subclass. The sum of squares for rows is 0.20. The resulting F-ratio is less than unity. The hypothesis that the row means are equal is accepted.

### The Hypothesis that the Column Means are Equal

The testing of this hypothesis determines if there is a significant difference in achievement in English and in Social Studies between the low achievement groups of Red Deer students and control students. The sum of squares for columns is 0.03. The resulting F-ratio is less than unity. The hypothesis that the column means are equal is accepted.

Acceptance of the hypothesis that the column means are equal leads to rejection of major hypothesis B. Rejection

## TABLE IX

## DATA FOR THE ANALYSIS OF VARIANCE: AGGREGATE ACHIEVEMENT FOR 1955, 1958 and 1961 ON GRADE XII DEPARTMENTAL EXAMINATIONS IN ENGLISH AND SOCIAL STUDIES (ROWS) OF THE LOW ACHIEVEMENT GROUP OF RED DEER AND CONTROL STUDENTS (COLUMNS)

| Subject | Item | School | | Totals and Means |
|---|---|---|---|---|
| | | Red Deer | Control | |
| English | N | 52 | 52 | 104 |
| | X | 2196.4 | 2130.3 | 4326.7 |
| | $\Sigma X^2$ | 95521.36 | 89449.07 | 184970.43 |
| | X | 42.2 | 41.0 | 41.6 |
| Social Studies | N | 32 | 32 | 64 |
| | X | 1301.3 | 1330.1 | 2631.4 |
| | $\Sigma X^2$ | 54300.23 | 56475.73 | 110775.96 |
| | X | 40.7 | 41.6 | 41.1 |
| Totals and Means | N | 84 | 84 | 168 |
| | X | 3497.7 | 3460.4 | 6958.1 |
| | $\Sigma X^2$ | 149821.59 | 145924.80 | 295746.39 |
| | X | 41.6 | 41.2 | 41.4 |

of major hypothesis B leads to rejection of minor hypotheses B-1 and B-2.

TABLE X

SUMMARY OF ANALYSIS OF VARIANCE FOR
DATA PRESENTED IN TABLE IX

| Source of Variation | Sum of Squares | Degrees Freedom | Mean Square | F-ratio |
|---|---|---|---|---|
| Schools | 0.03 | 1 | | |
| Subjects | 0.20 | 1 | | |
| Interaction | 1.10 | 1 | 1.10 | |
| Error | | 164 | 1.19 | |

The Hypothesis that the Interaction is Zero

Acceptance of this hypothesis would indicate that the relative achievement of the low achievement groups of Red Deer and control students is consistent between English and Social Studies. Rejection of the hypothesis would indicate that one or the other of the two groups of students achieved relatively better in one of the subjects than in the other subject.

The sum of squares for interaction is 1.10. The resulting F-ratio is less than unity. The hypothesis that the interaction is zero is accepted.

## V. MAJOR HYPOTHESIS C AND MINOR HYPOTHESES C-1 & C-2

Major hypothesis C states that the combined achievement for the years 1955, 1958 and 1961 in English and in

Social Studies of the average achievement groups of Red Deer students is significantly different from the combined achievement of the matching groups. The data used to test major hypothesis C are presented in Table XI. The analysis of variance is presented in Table XII, page 52.

The analysis of variance enables the testing of the following null hypotheses: (1) the hypothesis that the row means are equal, (2) the hypothesis that the column means are equal, and (3) the hypothesis that the interaction is zero.

### The Hypothesis that the Row Means are Equal

The testing of this hypothesis determines if there is a significant difference in achievement between English and Social Studies by the matched groups in the average achievement subclass. The sum of squares for rows is 0.14. The resulting F-ratio is less than unity. The hypothesis that the row means are equal is accepted.

### The Hypothesis that the Column Means are Equal

The testing of this hypothesis determines if there is a significant difference in achievement in English and in Social Studies between the average achievement groups of Red Deer students and control students. The sum of squares for columns is 3.08. The mean square for columns is 3.08. The mean square for error is 1.20. The resulting F-ratio of 2.57 is not significant at the .05 level of significance.

## TABLE XI

## DATA FOR THE ANALYSIS OF VARIANCE: AGGREGATE ACHIEVEMENT FOR 1955, 1958 AND 1961 ON GRADE XII DEPARTMENTAL EXAMINATIONS IN ENGLISH AND SOCIAL STUDIES (ROWS) OF THE AVERAGE ACHIEVEMENT GROUPS OF RED DEER AND CONTROL STUDENTS (COLUMNS)

| Subject | Item | School | | Totals and Means |
|---|---|---|---|---|
| | | Red Deer | Control | |
| English | N | 54 | 54 | 108 |
| | X | 2739.2 | 2672.6 | 5411.8 |
| | $\Sigma X^2$ | 141146.36 | 134997.48 | 276143.84 |
| | X | 50.7 | 49.5 | 50.1 |
| Social Studies | N | 30 | 30 | 60 |
| | X | 1527.6 | 1458.9 | 2986.5 |
| | $\Sigma X^2$ | 79219.98 | 72178.83 | 151398.81 |
| | X | 50.9 | 48.6 | 49.8 |
| Totals and Means | N | 84 | 84 | 168 |
| | X | 4266.8 | 4131.5 | 8398.3 |
| | $\Sigma X^2$ | 220366.34 | 207176.31 | 427542.65 |
| | X | 50.8 | 49.2 | 50.0 |

The hypothesis that the column means are equal is accepted.

TABLE XII

SUMMARY OF ANALYSIS OF VARIANCE FOR DATA PRESENTED IN TABLE XI

| Source of Variation | Sum of Squares | Degrees Freedom | Mean Square | F-ratio | $F_{05}$ |
|---|---|---|---|---|---|
| Schools | 3.08 | 1 | 3.08 | 2.57 | 3.91 |
| Subjects | 0.14 | 1 | | | |
| Interaction | 0.29 | 1 | | | |
| Error | | 164 | 1.20 | | |

Acceptance of the hypothesis that the column means are equal leads to rejection of major hypothesis C. Rejection of major hypothesis C leads to rejection of minor hypotheses C-1 and C-2.

## The Hypothesis that the Interaction is Zero

Acceptance of this hypothesis would indicate that the relative achievement of the average achievement groups of Red Deer and control students is consistent between English and Social Studies. Rejection of the hypothesis would indicate that one or the other of the two groups of students achieved relatively better in one of the subjects than in the other subject.

The sum of squares for interaction is 0.29. The resulting F-ratio is less than unity. The hypothesis that the interaction is zero is accepted.

## VI. MAJOR HYPOTHESIS D AND MINOR HYPOTHESES D-1 & D-2

Major hypothesis D states that the combined achievement for the years 1955, 1958 and 1961 in English and in Social Studies of the high achievement groups of Red Deer students is significantly different from the combined achievement of the matching groups. The data used to test major hypothesis D are presented in Table XIII. The analysis of variance is presented in Table XIV, page 55.

The analysis of variance enables the testing of the following null hypotheses: (1) the hypothesis that the row means are equal, (2) the hypothesis that the column means are equal, and (3) the hypothesis that the interaction is zero.

### The Hypothesis that the Row Means are Equal

The testing of this hypothesis determines if there is a significant difference in achievement between English and Social Studies by the matched groups in the high achievement subclass. The sum of squares for rows is 0.12. The resulting F-ratio is less than unity. The hypothesis that the row means are equal is accepted.

### The Hypothesis that the Column Means are Equal

The testing of this hypothesis determines if there is a significant difference in achievement in English and in Social Studies between the high achievement groups of Red

## TABLE XIII

### DATA FOR THE ANALYSIS OF VARIANCE: AGGREGATE ACHIEVEMENT FOR 1955, 1958 AND 1961 ON GRADE XII DEPARTMENTAL EXAMINATIONS IN ENGLISH AND SOCIAL STUDIES (ROWS) OF THE HIGH ACHIEVEMENT GROUPS OF RED DEER AND CONTROL STUDENTS (COLUMNS)

| Subject | Item | School | | Totals and Means |
|---|---|---|---|---|
| | | Red Deer | Control | |
| English | N | 46 | 46 | 92 |
| | X | 2748.9 | 2727.8 | 5476.7 |
| | $\Sigma X^2$ | 166873.49 | 164254.92 | 331128.41 |
| | X | 59.8 | 59.3 | 59.5 |
| Social Studies | N | 31 | 31 | 62 |
| | X | 1850.4 | 1819.2 | 3669.6 |
| | $\Sigma X^2$ | 111243.18 | 108828.20 | 220071.38 |
| | X | 59.7 | 58.7 | 59.2 |
| Totals and Means | N | 77 | 77 | 154 |
| | X | 4599.3 | 4547.0 | 9146.3 |
| | $\Sigma X^2$ | 278116.67 | 273083.12 | 551199.79 |
| | X | 59.7 | 59.1 | 59.4 |

Deer and control students. The sum of squares for columns is 0.56. The resulting F-ratio is less than unity. The hypothesis that the column means are equal is accepted.

TABLE XIV

SUMMARY OF ANALYSIS OF VARIANCE FOR DATA PRESENTED IN TABLE XIII

| Source of Variation | Sum of Squares | Degrees Freedom | Mean Square | F-ratio |
|---|---|---|---|---|
| Schools | 0.56 | 1 | | |
| Subjects | 0.12 | 1 | | |
| Interaction | 0.07 | 1 | | |
| Error | | 150 | 1.43 | |

Acceptance of the hypothesis that the column means are equal leads to rejection of major hypothesis D. Rejection of major hypothesis D leads to rejection of minor hypotheses D-1 and D-2.

### The Hypothesis that the Interaction is Zero

Acceptance of this hypothesis would indicate that the relative achievement of the high achievement groups of Red Deer and control students is consistent between English and Social Studies. Rejection of the hypothesis would indicate that one or the other of the two groups of students achieved relatively better in one of the subjects than in the other subject.

The sum of squares for interaction is 0.07. The

resulting F-ratio is less than unity. The hypothesis that the interaction is zero is accepted.

# CHAPTER V

# DISCUSSION OF THE RESULTS

## I. MAJOR HYPOTHESIS A

The purpose of testing major hypothesis A was to discover if there was a significant difference in gross achievement in English, Social Studies and Mathematics between Red Deer and control students for all the years 1955, 1958 and 1961. If differences in achievement between the two groups for all the years had been significant, minor hypotheses A-1, A-2 and A-3 would have been tested. As it was, differences in gross achievement were not significant. Major hypothesis A was rejected. Consequently minor hypotheses A-1, A-2 and A-3 were also rejected.

It was necessary that the data display one of two general properties in order that major hypothesis A be rejected. The first possibility was that differences in achievement by years between the two groups, without regard to direction, were of such minor nature that their cumulative effects were not significant. The other possibility was that the Red Deer group might achieve significantly better for a given year, while for some other year the control group would achieve significantly better. Acceptance of the hypothesis that the interaction is zero refutes this latter possibility. Major hypothesis A was rejected because the differences

between the two groups for all of the years were not significant.

An analysis of variance was used to test major hypothesis A. Had the null hypothesis that the column means were equal been accepted and, concomitantly the null hypothesis that the interaction is zero been rejected, major hypothesis A would still have been rejected. It would also have been wise, in the context of this study, to reject minor hypotheses A-1, A-2 and A-3. The research problem was motivated by the trimester system, a factor that remained constant during the three years under study. If the interaction, schools by years, had been statistically significant, it would have indicated the possibility that some of the uncontrolled extraneous variables had changed, favoring the Red Deer students one year, the control students another year.

The absence of a significant interaction does not necessarily mean that the major extraneous variables influencing achievement were well controlled in this study. It does not even mean that the effects of these extraneous variables remained constant during the years studied because the effects of a change in one variable could be compensated for by the effects of a change in some other variable. One can only interpret the lack of significant interaction to mean that the relative achievement of Red Deer and control students remained consistent over the years studied.

The purpose of using matched groups in the statistical analysis was to improve the homogeneity of variance within cells. Improved homogeneity is reflected in a smaller mean square for error. The risk of committing a Type II error, that is accepting the null hypothesis when it should be rejected, is thereby reduced. If the traits used for matching in this study were valid ones, then the probability of accepting the null hypothesis when it should have been rejected was diminished.

## II. MAJOR HYPOTHESES B, C AND D

The formulation and testing of major hypotheses B, C and D are, in a sense, independent of major hypothesis A. The achievement tested in hypothesis A was a composite of achievement in three subjects. The achievement tested in hypotheses B, C and D was a composite of achievement over three years. It was not possible to search for significant differences in achievement between Red Deer and control students on a subject basis when major hypothesis A was tested because a two-way analysis only (Schools by Years) was used. The design used in testing major hypotheses B, C and D made possible a comparison of the achievement of the two groups between English and Social Studies. Furthermore the comparison was made at three different levels of Grade IX achievement. It was important to study the relative achievement of Red Deer students in two different subjects at three

levels of achievement. The implication is that the trimester system might favor a particular subject and a particular level of achievement.

In testing each of major hypotheses B, C and D, the null hypothesis that the column means were equal was accepted in each case. The null hypothesis that the interaction was zero was also accepted in each case. Therefore major hypotheses B, C and D were rejected. The rejection of these major hypotheses resulted in the rejection of minor hypotheses B-1, B-2, C-1, C-2, D-1 and D-2. None of the differences in achievement between Red Deer and control students was significant.

## III. TREATMENTS BY YEARS FOR THE DIFFERENT ACHIEVEMENT LEVELS

It might be argued that the investigation of the achievement of the Red Deer students, at the different levels of Grade IX achievement, could also be studied by a two-way design in which row means would constitute the combined achievement in English and Social Studies for a given year, and the column means would constitute the achievement by years. In other words, the design for testing research hypotheses B, C and D would be similar to that for testing research hypothesis A. The weakness in such an argument is that hypothesis A is the more inclusive one. Reference has been made to the hazards inherent in testing subordinate

hypotheses for significant differences when significance has not been indicated by a test of the major hypothesis. As it was, a different design was used to test hypotheses B, C and D. The design used in the test of major hypothesis A dealt with achievement by years; no comparison was made between subjects. The design used to test major hypotheses B, C and D dealt with achievement by subjects; no comparison was made among years.

## IV. MATHEMATICS ACHIEVEMENT

The absolute achievement in mathematics of the Red Deer group exceeded that of the control group for each of the years 1955, 1958 and 1961 (Tables V & VI). The temptation is to test for significant differences in achievement in mathematics not withstanding that major hypothesis A has been rejected. The validity of such a test would be doubtful.

In the first place, rejection of major hypothesis A indicates no significant differences in total achievement between the Red Deer and control groups. The differences in achievement between the two groups in mathematics could be due to the influence of random variation. Differences could also be due to the influence of uncontrolled extraneous variables within the subject field of mathematics. Furthermore, the comparative reliability of the achievement scores in mathematics is questionable because the numbers of students

involved is so much less than the numbers of students in the other two subjects.[41] Therefore the relative achievement of the Red Deer students in mathematics should be gauged by the relative achievement of the Red Deer students in the other subjects.

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[41] Selltiz and others, *op. cit.*, pp. 182-83.

# CHAPTER VI

# CONCLUSIONS AND RECOMMENDATIONS

## I. CONCLUSIONS

This study sought to explore one aspect of the effectiveness of the trimester system used in the Red Deer school. The specific research hypotheses were designed to assess the learning effectiveness of the Red Deer groups in English, Social Studies and Mathematics for the years 1955, 1958 and 1961. Statistical treatment of the data indicated that none of the differences in achievement between the Red Deer and control groups was significant.

The study was limited to those students who had progressed normally through the high school grades. It did not assess the achievement of those students who might find the trimester system attractive for special reasons: to fulfill prerequisites to further study, to capitalize on peak employment periods, to facilitate the removal of course deficiencies (Chapter I). The desire to accommodate these special students was one of the major reasons for inaugurating the trimester system. The value of any appraisal of the trimester system ignoring these special students is limited.

Not withstanding the above limitation, this study performed a necessary function. It is important that the

normal student be accommodated, even while provision is being made for the special student. This study has demonstrated that the normal student can be accommodated. The fact that the achievement of the Red Deer students, for the subjects and years studied, was on a par with that of the control students is even more impressive when one considers that the programs of studies, which had evolved on a trial-and-error basis over the years to an optimum time span of nine months, were used without any special adaptations in content for the trimester system.

## II. RECOMMENDATIONS

The status of the trimester system cannot be adequately judged until other aspects have been appraised. The purpose of this section is to record some areas which might be studied with profit.

### The Special Student

The apparent flexibility of the trimester system means that a study of the status and relative importance of the special student should have an early priority. The opinion cited by the Royal Commission on Education in Alberta could be used to supply the working hypotheses for such an investigation. The study must go beyond a comparative evaluation of the trimester system and the conventional school-year organization. The special student must be defined and classified.

Then the study should assess the relative merits of the trimester system for each category: the gifted, the remedial, the student of mature years, and so on.

## Learning Effectiveness

The present study has shown that the achievement of specified groups of Red Deer students has not differed significantly from that of the control groups. The measures of achievement were the results of Grade XII Departmental examinations. It would be of value to compare the retention of knowledge subsequent to the June examinations. Such a study is necessary in order to determine the long-term effectiveness of learning under the trimester system.

It might also be profitable to design a study to investigate the merits of immediate versus deferred goals. The present study did not refer directly to such a comparison, but the results imply the one is no more effective than the other. It is possible that a research design relating specifically to a test of immediate versus deferred goals would reveal important differences.

Another aspect of learning effectiveness under the trimester system should also be considered. The program of studies in the Red Deer school has been compressed into a three-month course with no change in content. An alternative approach would be to continue with the same elapsed time --- nine months --- and break each course up into three equal parts, or units. This is not a picayune suggestion. In the

first place, there is nothing magic nor sacred about our present time span in use under the conventional system. Furthermore, the present system recognizes that it is wise to master the simple before proceeding to the complex. Thus year-end examinations are held in order to determine if a student is ready to proceed to the next higher level. The defect in the conventional system may be that the interval between major examinations is too long. It may be more efficient to break the cycle into two or three terms with provision made to repeat the course by those who need it at the end of each term. Under the present system the student may be left to flounder for a full year before provision is made for him to repeat the course. The efficiency of the present system is questionable. A study of reorganization possibilities might result in important implications for curriculum planners.

### Staff and Plant Utilization

The underlying advantage of the trimester system seems to be its greater flexibility. The extent of this flexibility should be determined, not only with respect to meeting the needs of the special student, but also with respect to staff utilization and staff-student relations. The advent of programed learning, "modern" courses of study and team teaching is designed to increase the flexibility of the conventional year, to meet the needs of, and challenge every student in the school. It is possible that these innovations might have even

greater implications under the trimester system.

The trimester system in use at Red Deer does not seem to make more efficient use of school buildings. Little will be gained in plant utilization until schools commence operation on a full-year basis. There is evidence that a trend towards a longer school-year exists in the growing development of summer schools. An extension of the trimester system to the four-quarter system might put the summer school programs on a sounder basis. A study of the relationship between the trimester system and the extended school-year would be profitable. A special aspect of such a study would relate to improved articulation between high school and university courses, not only with respect to the present organization at the university, but also with respect to any foreseeable changes the university might make.

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